# Pop-Up Flat Folding Explorer Robotics (PUFFER)

Completed Technology Project (2015 - 2017)

## Project Introduction

PUFFER is a low-volume, low-mass, low-cost mission enhancement for high-reward extreme terrain science

## Anticipated Benefits

NASA funded: The PUFFER technology provides a simple, low-cost robotic mission enhancement for accessing new high-value extreme terrains that are beyond the scope of the primary mission. In this way, PUFFER extends the scientific yield of future NASA missions with little added cost and minimal burden. Currently funded NASA missions that can benefit from carrying add-on PUFFERs include the Mars 2020 rover and Europa lander. NASA unfunded: PUFFER can provide simple, low-cost robotic mobility for a wide variety of future NASA missions due to its low payload requirement. PUFFERs can provide surface mobility to otherwise stationary landers on planetary and small bodies. PUFFERs can also enhance the mobility of future rovers by providing access into difficult terrains that are beyond the design scope of the primary rover, or are better addressed with PUFFER's compact form factor. PUFFERs may also provide low-cost mobility benefits to future human missions by providing tele-robotic scouting and inspection capabilities. OGA: The PUFFER technology has applications in the DoD, DoJ and emergency response realms, where it can be used as a low-cost, stealthy, and easily-deployable tele-operated platform for reconnaissance, surveillance, or search-and-rescue type operations. Commercial: This item does not benefit the commercial space industry. Nation: The PUFFER effort is funding research in origami-inspired millirobots at U.C. Berkeley. The PUFFER effort is also working with Distant Focus Corp. (Champaign, IL), which is funded through SBIR, to advance novel folded optics technology which has many promising space and commercial applications.


Pop-Up Flat Folding Explorer Robotics

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## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Jet Propulsion Laboratory (JPL)

**Responsible Program:**

Game Changing Development

**Game Changing Development**

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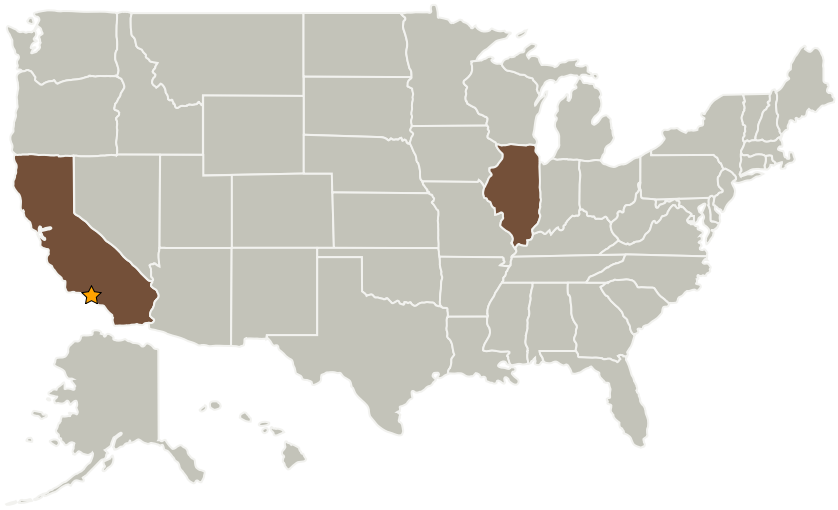
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Jet Propulsion Laboratory(JPL) | Lead Organization | NASA Center | Pasadena, California |
| Distant Focus Corporation | Supporting Organization | Industry | Champaign, Illinois |
| University of California-Berkeley(Berkeley) | Supporting Organization | Academia | Berkeley, California |

| Primary U.S. Work Locations | |
|---|---|
| California | Illinois |

## Project Transitions

**October 2015:** Project Start

## Project Management

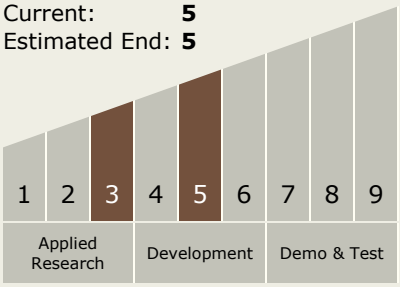
**Program Director:**
Mary J Werkheiser

**Program Manager:**
Gary F Meyering

**Principal Investigator:**
Jaakko Karras

## Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**




## Target Destination

Mars

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**September 2017:** Closed out

**Closeout Summary:** The project built and test several models of the Mars PUFFER and at least one model of the Earth PUF FER (sometimes called the red and blue PUFFERS). The Mars PUFFER achieved TRL5 and was field tested in a Mars analog e nvironment. The components were tested in thermal vacuum. The Earth PUFFER needs more development of requirements and design work and therefore would be considered a TRL4. The project met 3 out of 5 threshold Key Performance Paramet ers that were baselined. Customer feedback asked the team to change/not meet the last two Key Performance Parameters which had to do with mass and volume.

## Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html